AMENDMENTS TO THE CLAIMS

The claims are amended as follows:

1. (Currently Amended) A method of estimating end-to-end path capacity in a network, comprising:

probing an end-to-end path to identify addresses of all hops on the end-to-end path;

generating and transmitting, by a terminal node on the end-to-end path, a first time-stamp request packet to a first hop and subsequent two time-stamp request packets to a second hop, wherein the first time-stamp request packet and the subsequent two time-stamp request packets are three consecutive request packets, and the first hop and the second hop are two consecutive hops on the end-to-end path;

receiving an initial time stamp from the first hop and two subsequent time stamps from the second hop in response to the three consecutive request packets;

~~generating a pair of time-stamp request packets;~~

generating and transmitting, by the terminal node, ~~the~~ a first packet of a pair of consecutive time-stamp request packets to ~~two consecutive hops on the end-to-end path~~the first hop and a second packet of the pair to the second hop;

~~generating a first time-stamp at a first hop of the two consecutive hops and a second time-stamp at a second hop of the two consecutive hops, in response to the pair of time-stamp request packets;~~ and

receiving and processing at least one~~the first time-stamp and the second~~ time-stamp generated by the two consecutive hops to produce at least one QoS estimate of a link that couples the two consecutive hops on the end-to-end path.

2. (Original) The method of claim 1, wherein probing on the end-to-end path comprises using a Traceroute application to identify hops on the end-to-end path.

3. (Original) The method of claim 1, wherein probing the end-to-end path occurs from one selected from a group consisting of a source node, a destination node, and both a source node and a destination node.

4.   (Original) The method of claim 1, wherein processing the time-stamp is performed at one selected from a group consisting of a source node, a destination node, and both a source and destination node.

5.   (Original) The method of claim 1, wherein the time-stamp request packets are ICMP requests.

6.   (Original) The method of claim 1, wherein the number of generated and processed time-stamp request packets is at least five.

7.   (Original) The method of claim 1, further comprising generating pairs of time-stamp request packets more often to specific hops on the end-to-end path.

8.   (Original) The method of claim 7, wherein hops subject to more frequent probing are determined based on at least one of:
       a variation pattern of utilization;
       a queuing delay, a queue size, a processing delay, an available bandwidth, and a congestion status.

9.   (Original) The method of claim 1, further comprising generating time-stamp requests less often to specific hops on the end-to-end path.

10.   (Original) The method of claim 9, wherein hops subject to less frequent probing are determined based on at least one of:
       a variation pattern of utilization;
       a queuing delay, a queue size, a processing delay, an available bandwidth, a congestion status.

11.   (Original) The method of claim 1, further comprising introducing certain latency between consecutive time-stamp request packet transmissions.

12.   (Currently Amended) The method of claim 1, further comprising increasing ~~the~~ a time-stamp request packet size by adding dummy data to ~~the~~ one or more of the time-stamp request ~~packet~~ packets to increase sensitivity in the case of a fast link.

13.   (Currently Amended) The method of claim 5, further comprising increasing ~~the~~ a ICMP request size by adding dummy data in an IP payload field of an ICMP request to increase sensitivity in the case of a fast link.

14.   (Original) The method of claim 1, wherein the QoS estimate comprises a link and path capacity.

15.   (Previously Presented) The method of claim 1, wherein the QoS estimate comprises an estimate of queuing delay at one of the two consecutive hops.

16.   (Original) The method of claim 1, wherein the QoS estimate comprises an estimate of link and path utilization.

17.   (Original) The method of claim 1, wherein the QoS estimate comprises an estimate of link and path available bandwidth.

18.   (Previously Presented) The method of claim 1, wherein the QoS estimate comprises an estimate of interfering flows at one of the two consecutive hops.

19.   (Original) The method of claim 1, further comprising restarting probing of the end-to-end path in the case of a change in routing tables.

20.   (Currently Amended) An article of manufacture having one or more recordable media storing instructions thereon which, when executed by a system, cause the system to estimate end-to-end path capacity in a network by:
        probing an end-to-end path to identify addresses of all hops on the end-to-end path;

generating and transmitting a first time-stamp request packet to a first hop and subsequent two time-stamp request packets to a second hop, wherein the first time-stamp request packet and the subsequent two time-stamp request packets are three consecutive request packets, and the first hop and the second hop are two consecutive hops on the end-to-end path;

receiving an initial time stamp from the first hop and two subsequent time stamps from the second hop in response to the three consecutive request packets;

~~generating a pair of time-stamp request packets;~~

generating and transmitting ~~the~~ a first packet of a pair of time-stamp request packets to the first hop and a second packet of the pair to the second hop~~two consecutive hops on the end-to-end path~~;

~~generating a first time-stamp at a first hop of the two consecutive hops and a second time-stamp at a second hop of the two consecutive hops, in response to the pair of time-stamp request packets; and~~

receiving and processing at least one~~the first time-stamp and the second~~ time-stamp generated by the two consecutive hops to produce at least one QoS estimate of a link that couples the two consecutive hops on the end-to-end path.

21.   (Currently Amended) A router comprising:

a queue to store outgoing packets;

IP processing coupled to the queue to probe an end-to-end path in a network to identify addresses of all hops on the end-to-end path, generate and transmit a first time-stamp request packet to a first hop and subsequent two time-stamp request packets to a second hop, wherein the first time-stamp request packet and the subsequent two time-stamp request packets are three consecutive request packets, and the first hop and the second hop are two consecutive hops on the end-to-end path, receive an initial time stamp from the first hop and two subsequent time stamps from the second hop in response to the three consecutive request packets, generate and transmit a first packet of a pair of time-stamp request packets to the first hop and a second packet of the pair to a second hop~~two consecutive hops on the end-to-end path~~, and receive and process at least one~~a first time-stamp generated at a first hop of the two consecutive hops and a second~~ time-stamp generated by ~~at a second hop of~~ the two consecutive hops to produce at least one QoS estimate of a link that couples the two consecutive hops on the end-to-end path.

22.   (Currently Amended) A method of estimating end-to-end path capacity in a network, comprising the steps of:

probing an end-to-end path to identify addresses of a plurality of hops on the end-to-end path;

generating and transmitting, by an origination node on the end-to-end path, a first time-stamp request packet to a first hop and subsequent two time-stamp request packets to a second hop, wherein the first time-stamp request packet and the subsequent two time-stamp request packets are three consecutive request packets, and the first hop and the second hop are two consecutive hops on the end-to-end path at least one time-stamp request packet with an origination node;

receiving an initial time stamp from the first hop and two subsequent time stamps from the second hop in response to the three consecutive request packets;

generating and transmitting sending, by the origination node, a first packet of a pair of the time-stamp request packet packets to at least one respective hop on the end-to-end path the first hop and a second packet of the pair to the second hop, the at least one pair of time-stamp request packet packets having an origination address of the origination node spoofed to that of another hop on the network;

generating at least one time-stamp with the hop; and

receiving and processing in at least one hop on the network the at least one time-stamp to produce a QoS estimate.

23.   (Original) The method of claim 22, wherein probing the end-to-end path comprises using a Traceroute application to identify addresses of the plurality of hops.

24.   (Original) The method of claim 22, wherein the origination address is that of a source node on the end-to-end path.

25.   (Original) The method of claim 22, wherein the origination address is that of a destination node on the end-to-end path.

26.   (Original) The method of claim 22, wherein probing the end-to-end path is generated from a source node.

27.   (Original) The method of claim 22, wherein probing the end-to-end path is generated from a destination node.

28.   (Original) The method of claim 22, wherein probing the end-to-end path is generated from a source node and a destination node.

29.   (Original) The method of claim 22, wherein the QoS estimate comprises an estimate of link and path capacity.

30.   (Currently Amended) The method of claim 22, wherein the QoS estimate comprises an estimate of queuing delay at <u>one of the two consecutive hops</u>the hop.

31.   (Original) The method of claim 22, wherein the QoS estimate comprises an estimate of link and path utilization.

32.   (Original) The method of claim 22, wherein the QoS estimate comprises an estimate of link and path available bandwidth.

33.   (Currently Amended) The method of claim 22, wherein the QoS estimate comprises an estimate of interfering flows at <u>one of the two consecutive hops</u>the hop.

34.   (Original) The method of claim 22, further comprising refining the QoS estimate by taking into consideration a propagation delay.

35.   (Currently Amended) An article of manufacture having one or more recordable media storing instructions thereon which, when executed by a system, cause the system to estimate end-to-end path capacity in a network by:

probing an end-to-end path to identify addresses of a plurality of hops on the end-to-end path;

generating and transmitting, by an origination node, a first time-stamp request packet to a first hop and subsequent two time-stamp request packets to a second hop, wherein the first time-stamp request packet and the subsequent two time-stamp request packets are three consecutive request packets, and the first hop and the second hop are two consecutive hops on the end-to-end path~~at least one time-stamp request packet with an origination node~~;

receiving an initial time stamp from the first hop and two subsequent time stamps from the second hop in response to the three consecutive request packets;

generating and transmitting, by an origination node, a first packet of a pair of time-stamp request packets to the first hop and a second packet of the pair to the second hop~~sending said time-stamp request packet to at least one respective hop on the end-to-end path~~, the ~~at least one~~pair of time-stamp request ~~packet~~packets having an origination address of said origination node spoofed to that of another hop on said network;

~~generating at least one time-stamp with said hop;~~ and

receiving and processing in at least one hop on said network ~~said~~at least one time-stamp generated by the two consecutive hops to produce a QoS estimate.

36. – 56.   (Canceled)

57.   (Currently Amended) A method comprising:

probing, by a terminal node on an end-to-end path, the end-to-end path to identify capacity of routers on the end-to-end path, the end-to-end path including a wireless link;

transmitting, by the terminal node, ~~a pair of~~ping requests interleaved with voice packets to ~~two consecutive hops~~a hop on the path;

receiving, by the terminal node, a ~~first~~ping reply ~~from a first hop of the two consecutive hops and a second ping reply from a second hop of the two consecutive hops, in response to the pair of ping requests, the first ping reply indicating a first time-stamp generated at the first hop and the second ping reply indicating a second time-stamp generated at the second hop~~; and

processing the ~~first~~ping reply ~~and the second ping replay~~ to generate a quality of service (QoS) estimate~~of a link that couples the two consecutive hops on the end-to-end path~~.

58.   (Original) The method defined in Claim 57 wherein the hop comprises a hop on an IEEE 802.11 wireless local area network (LAN).

59.   (Currently Amended) An article of manufacture having one or more recordable media storing instructions thereon which, when executed by a system, cause the system to:

probe an end-to-end path to identify capacity of routers on the end-to-end path, the end-to-end path including a wireless link;

transmit a pair of ping requests interleaved with voice packets to two consecutive hopsa hop on the path;

receive a first ping reply from a first hop of the two consecutive hops and a second ping reply from a second hop of the two consecutive hops, in response to the pair of ping requests, the first ping reply indicating a first time-stamp generated at the first hop and the second ping reply indicating a second time-stamp generated at the second hop; and

process the first ping reply and the second ping reply to generate a quality of service (QoS) estimate of a link that couples the two consecutive hops on the end-to-end path.

60. – 62.   (Canceled)

63.   (New) The method of claim 57, wherein time intervals between the ping requests vary according to a packet loss model.